

Review on the therapeutic activities of the Genus *Pouteria*

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Abstract— The genus *Pouteria*, of the Sapotaceae family, is composed of plants that have representatives with great potential to be used in herbal formulations in order to combat pathogens and treat diseases that affect human health. Triterpenes and flavonoids are the most common constituents found in this genus. Despite the various uses of these plants in folk medicine to treat fever, inflammation, skin rashes, ulcers, diabetes, diarrhea, nausea, vomiting, pain and promoting lactation. Few scientific studies proving their safety and therapeutic effectiveness. Studies found in the literature make references that the species of the genus *Pouteria* presents promising results as immunomodulator, antidiabetic, antioxidant, neuroprotective, hepatoprotective and antimicrobial among other actions. This genus can be better investigated for use in herbal formulations that aim to combat or treat numerous diseases, including some like cancer and diabetes that still has no cure. In view of this and in view of the increasingly frequent search for natural substances that have effective therapeutic activities, this review highlights the great biotechnological potential, as well as the main therapeutic applications of species of this genus found in the literature and to stimulate new studies on the use of these plants in the treatment and even prevention of various diseases. For this, a survey was carried out on the topic in the main sources of scientific research in the period from 2010 to 2020, leading us to conclude that this genus can be a potent ally in the search for new phytotherapy drugs of great benefit to human health.

Keywords— Fitoterapy, *Pouteria*, plants, Sapotaceae, treatment.

I. INTRODUCTION

Since antiquity, medicinal plants and their derivatives, such as essential oils, have been used to treat various diseases. In the last decades, the search for alternative therapies has been gaining strength and studies have been done to prove its effectiveness. Brazil has the largest diversified forest reserve on the planet. Many species are used for medicinal purposes and used with little or no evidence of their pharmacological properties. Medicinal plants are an important component of health care for the majority of the world's population: they constitute the main medical care for 70% to 95% of citizens in most de-

veloping countries and are increasingly used by a large number of people who reside in wealthier countries [1].

The interest in the discovery of new substances makes scientists from various areas search, in the Brazilian Flora, plant species with medicinal properties used by the population [2]. In Brazil, the Ministry of Health has sought to encourage the insertion of medicinal plants in the health system, through national policies [3]. There is worldwide interest in studying the use of different medicinal plants, from different regions, for the treatment of diseases.

Sapotaceae is a family of plants that can be found worldwide, distributed mainly in tropical and subtropical regions, with great representation in the Amazon region and the Atlantic Forest [4,5,6]. According to Flora do Brazil 2020, 13 genus, 243 species and 26 subspecies distributed throughout Brazil have now been described, including 106 species and 02 endemic subspecies [7].

This family is made up of shrubs or trees and has alternating leaves, with little or no verticillation or opposite, simple, usually without stipules and the entire margin in general. Its inflorescence is jerky, usually in panicles or reduced to axillary fascicles. Its flowers, little showy, are unisexual or bisexual and their fruits are berry type [8].

Many plants in the Sapotaceae family produce edible fruits [9]. Also, it has great relevance in the timber industry due to the properties of its wood - *maçaranduba*, representing a great economic value [10].

The genus *Pouteria* Aublet is the largest botanical genus belonging to the Sapotaceae family, which includes about 127 species and 8 subspecies [11]. Most species occur in South America, mainly in low-lying and humid forest regions [12]. Plants of this genus have representatives with great potential to be used in herbal formulations to combat pathogens and treat numerous diseases. Triterpenes and flavonoids are the most common constituents found in this genus. Long-chain hydrocarbons, alcohols, acids and esters are also found mainly in species that occur in dry regions, for example, Savanna. The immunomodulatory and antimicrobial actions of some species have been investigated and proven [9,13].

Despite the diverse uses of plants of this genus in folk medicine to treat fever, inflammation, skin rashes, ulcers, diabetes, diarrhea, nausea, vomiting, back pain and to promote lactation. There is little scientific evidence for most of these biological activities [9]. So more studies are needed to prove and discover their actions. The purpose of this review is to gather data on *Pouteria* species, their main therapeutic applications and to stimulate further studies on this genus in the treatment of various diseases.

II. METHODOLOGY

A survey was carried out on the theme between the years 2010 and 2020, in that period the largest number of publications on the theme were found. The main sources of scientific research were used, using the descriptors consulted in the DEC's (Health Science Descriptors): Sapotaceae family; genus *Pouteria*; therapy and disease, as well as its synonyms and correspondents in Portuguese: Família Sapotaceae; gênero *Pouteria*; tratamento and doença. The main sources of research used were: PubMed, Scielo, Thieme, EBSCO Host, Journals Capes and Flora do Brasil-JBRJ (Table 1).

The analysis of the articles was carried out in three stages. The first stage was carried out by reading the title of the articles, where only those with terms related to the Sapotaceae family or genus *Pouteria* were selected. Then, we moved on to the second stage, in which the Summary or Abstract of the articles included in the first phase was read, among which were chosen those that mentioned some type of effective treatment for diseases using plants of the genus *Pouteria*. Finally, in the third and last stage, the full text of the articles selected in the second stage was evaluated, to elect articles that discussed the use and importance of *Pouteria* species used in the treatment of diseases and in the fight against pathogens that cause of diseases in humans.

Articles that mentioned only the empirical use of plants were excluded, in addition to studies carried out before 2010. It should also be noted that articles repeated in the databases and articles with incomplete research information were eliminated. The study ended with 32 articles, of which 20 were used in the result, as they evaluate the therapeutic activities of the genus *Pouteria* and 12 were used to compose the introduction and/or discussion.

Table. 1: Result of the survey carried out on the topic in the main research sources

Database	Total articles	Excluded after reading the abstract	Read in full	Selected
PUBMED	26	10	16	16
THIEME	3	1	2	2
EBSCO Host	2	2	0	0
SCIELO	11	2	9	9
CAPES JOURNALS	4	4	0	0

FLORA DO BRASIL-JBRJ	5	0	5	5
Total	51	19	32	32

Databases used to search for articles: Pubmed, Thieme, EBSCO Host, Scielo, Capes Journals and Flora of Brazil

III. RESULT AND DISCUSSION

Plants of the genus *Pouteria*, have representatives with great potential to be used in herbal formulations to combat pathogens and treat numerous diseases. Table 2 lists the authors' names in alphabetical order, the articles published from 2010 to 2020 in Brazil and worldwide, highlighting the species of the genus *Pouteria* that were studied, the part of the plant used, as well as the form used

in the tests, the therapeutic activity found and the constituents that may be responsible for this activity, totaling 20 articles. It is important to note that of these, 11 articles were carried out in Brazil, reaffirming the interest of Brazilian researchers in medicinal plants and their derivatives for the treatment and prevention of numerous diseases, and 9 articles were carried out in other countries of the world.

Table. 2: Survey of studies on the main therapeutic applications of the genus *Pouteria*

Species	Application	Used part	Form used	Constituent of the plant	Authors	Year/ Country
<i>Pouteria ramiflora</i> (Mart.) Radlk., <i>Pouteria torta</i> (Mart.) Radlk., <i>Pouteria caimito</i> (Ruiz & Pav.) Radlk.	α -glucosidase, α -amylase reduction	leaf, stem, bark, fruit	hexane ethanolic extracts	flavonoids, tannins	Souza et al.	2012 Brazil
<i>Pouteria ramiflora</i> (Mart.) Radlk.	α -amylase reduction, blood glucose	leaf, bark, root	aqueous ethanolic hexane extracts	phenolic compounds, tannins, triterpenes	Golveia et al.	2013 Brazil
<i>Pouteria ramiflora</i> (Mart.) Radlk.	neuroprotective	leaves	ethanolic extract	flavonoids	Da Costa et al.	2013 Brazil
<i>Pouteria ramiflora</i> (Mart.) Radlk., <i>Pouteria torta</i> (Mart.) Radlk.	antifungal	leaves	aqueous, ethanolic extracts	flavonoids, catechin	Correia et al.	2016 Brazil
<i>Pouteria ramiflora</i> (Mart.) Radlk.	α -amylase reduction	leaves	hexane extract, fraction - hexane: ethyl acetate (Ac-OEt)	friedelina, epi-friedelanol, taraxerol	Rodrigues et al.	2017 Brazil
<i>Pouteria ramiflora</i> (Mart.) Radlk.	antitumor, antimitagenic	leaves	hydroalcoholic extract	flavonoids	Tuttis et al.	2018 Brazil

<i>Pouteria torta</i> (Mart.) Radlk.	anticancer	leaf	hexane ethanolic aqueous extracts	α -amyirin acetate, β -amyirin acetate, betulinic acid, ursolic acid, mixture of α - and β -friedelinol	Elias et al.	2013 Brazil
<i>Pouteria torta</i> (Mart.) Radlk.	mutagenic	leaf	hydroethanolic extract	flavonoids	Costa et al.	2014 Brazil
<i>Pouteria torta</i> (Mart.) Radlk.	α -amylase inhibitor, antioxidant	epicarp	aqueous extract	phenolic compounds flavonoids	De Sales et al.	2017 Brazil
<i>Pouteria lucuma</i> (Ruiz & Pav.) Kuntze	anti-inflammatory, healing	fruit	walnut oil	linoleic acid, palmitic acid, stearic acid	Rojo et al.	2010 Chile
<i>Pouteria lucuma</i> (Ruiz & Pav.) Kuntze	antioxidant, antihyperglycemic	fruit	fractions hydrophilic, lipophilic	carotenoid, flavonoids, triterpenes	Fuentetaja et al.	2015 Chile
<i>Pouteria lucuma</i> (Ruiz & Pav.) Kuntze	antioxidant, gastroprotective	seed	methanolic extract	amino acids, organic acids, nucleosides, phenolic acids, tannins, flavonoids, triterpenoids	Guerrero-castillo et al.	2019 Chile
<i>Pouteria sapota</i> (Jacq.) H.E. Moore & Stearn	improves postprandial absorption	bark, seed	a mixture of methyl tert-butyl ether and methanolic extracts	carotenoids carotenoid esters	Chacón-Ordóñez et al.	2017 Germany
<i>Pouteria sapota</i> (Jacq.) H.E. Moore & Stearn	anticancer	leaf	aqueous extract	polyphenols	Prabhu et al.	2018 India
<i>Pouteria sapota</i> (Jacq.) H.E. Moore & Stearn	antidiabetic	leaf	aqueous extract, nano silver particle	polyphenols	Prabhu et al.	2018 India
<i>Pouteria campechiana</i> (Kunth) Baehni	hepatoprotective, antioxidant	fruit	aqueous extract	phenolic compounds flavonoids	Aseervatham et al.	2013

				noids		India
<i>Pouteria campechiana</i> (Kunth) Baehni	antinociceptive, anti hyperalgesic	leaf	ethanolic extract	Not mentioned	Déciga-campos et al	2016 Mexico
<i>Pouteria mammosa</i> (L.) Cronquist	acute oral toxicity, eye irritability	seed	aqueous hydroalcoholic extracts	coumarins, saponins, phenols, tannins	Dutok et al	2015 Cuba
<i>Pouteria macrophylla</i> (Lam.) Eyma	antioxidant	fruit	aqueous extract	polyphenolic compounds	Gordon et al.	2011 Brazil
<i>Pouteria venosa</i> (Mart.) Baehni	antimicrobial, cytotoxic	leaf, stem bark	ethanolic extract	Not mentioned	Santos et al.	2015 Brazil

Articles published from 2005 to 2020 in Brazil and the world, standing out as a species of the genus *Pouteria* that were studied, the part of the plant used, as well as the form used, the therapeutic application found, and the constituents that may be responsible for this activity.

In this review (20) articles were found that investigated the therapeutic activities of 09 species of the genus *Pouteria*. When we analyzed the form of preparation used in the tests, we saw that (16) articles used the crude extract (leaf, bark, stem, root, fruit, seed, epicarp, and/or seed), (01) article used walnut oil, (01) article used hydrophilic, lipophilic fractions and (02) article used crude extract and fractions (green synthesis of silver nanoparticles (AgNPs) and hexane fractions: ethyl acetate (AcOEt). The species

and the number, in addition, it is possible to see in Figure 1. The species that presented more studies, with emphasis on the *Pouteria ramiflora* (Mart.) Radlk. species with (06) studies, *Pouteria torta* (Mart.) Radlk., with (05) studies and *Pouteria lucuma* (Ruiz & Pav.) Kuntze and *Pouteria sapota* (Jacq.) H.E. Moore & Stearn, each presenting (03) studies.

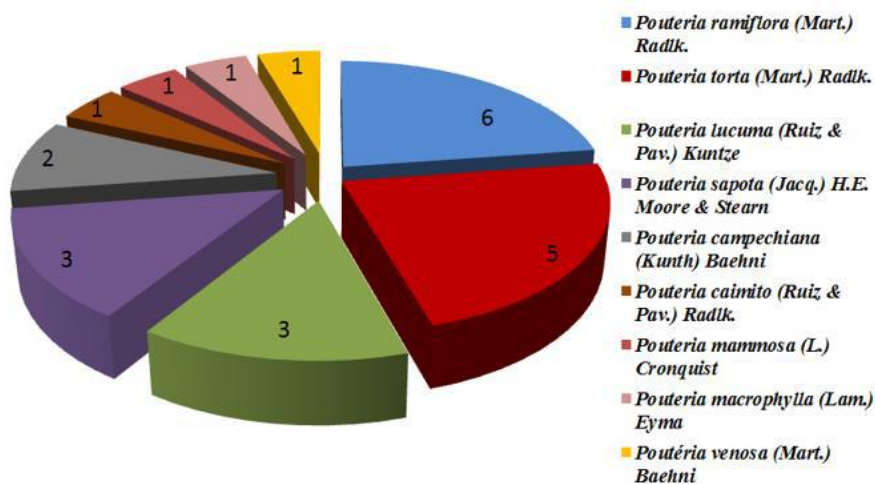


Fig. 1: Number of articles by *Pouteria* species

Phytochemical analysis of some *Pouteria* species revealed the presence of compounds such as flavonoids that were linked to antitumor, antimutagenic and neuroprotective action. Polyphenols related to anticancer, antidiabetic and antioxidant activity were also found. These findings often

provide a scientific basis and prove the uses of these species in traditional medicine. Table 3 highlights the popular name of the species of the genus *Pouteria* found in this review, as well as their use in traditional medicine.

Table. 3: Popular name and use in the traditional medicine of *Pouteria* species mentioned in this review.

Species	Popular name	Traditional use
<i>Pouteria ramiflora</i> (Mart.) Radlk.	curriola (curiola) do Cerrado, abiu piloso	antihyperlipidemic verminous, antifungal, antioxidant, dysentery, pain, inflammation
<i>Pouteria torta</i> (Mart.) Radlk.	abiurana-curriola-liso, pateiro, guapeva, abiu do Cerrado	antidiarrheal, antimicrobial, antifungal
<i>Pouteria caimito</i> (Ruiz & Pav.) Radlk.	abiu, abiurana, caimito, red abiurana	antimicrobial, antimalarial, antioxidant, photoprotective, dysentery, pain, inflammation
<i>Pouteria lucuma</i> (Ruiz & Pav.) Kuntze	lucuma	anticancer, immunostimulant, anti-inflammatory, lowers blood pressure
<i>Pouteria campechiana</i> (Kunth) Baehni	yellow sapota canistel	antinociceptive, anti-hyperalgesic
<i>Pouteria sapota</i> (Jacq.) H.E. Moore & Stearn	mamay	seborrheic, anthelmintic, digestive, dermatitis
<i>Pouteria mammosa</i> (L.) Cronquist	zapote ou mamey	fever, inflammation, rashes, ulcers, nausea, vomiting, diabetes
<i>Pouteria macrophylla</i> (Lam.) Eyma	cutite	anti-inflammatory
<i>Pouteria venosa</i> (Mart.) Baehni	tuturubá, leiteiro, bapeba, black sapota	antimicrobial

Popular name and use in the traditional medicine of the species of the genus *Pouteria*.

We report below the main therapeutic actions found for each species:

Pouteria ramiflora (Mart.) Radlk, a species that occurs in the Brazilian Cerrado, has been studied due to its possible ability to inhibit the digestion of carbohydrates in rats with diabetes. Diabetes in animals was induced by streptozotocin and when treated with *Pouteria ramiflora* (Mart.) Radlk alcoholic extract showed an improved glycemic level, increased activity of glutathione peroxidase, decreased activity of superoxide dismutase, and reduction of lipid peroxidation. The extract of this plant exerted a neuroprotective effect against oxidative damage and myosin-Va expression and was shown to prevent neuronal loss of the hippocampus in the subfields CA3 and Hilo of diabetic rats [14].

Another study using the same species, *Pouteria ramiflora* (Mart.) Radlk revealed that the hydroalcoholic extract of the leaves of this plant presents flavonoids (myricetin-3-O- β -D-galactopyranoside and myricetin-3-O- α -L-rhamnopyranoside). Such extract revealed cytotoxic action in human hepatocarcinoma (HepG2) and non-tumor

primary gastric cells and also antimutagenic action, observing a significant decrease in DNA damage [15].

Rodrigues and collaborators (2017), showed that the F1 - 1/4 hexane and F2 - 1/4 hexane fractions: ethyl acetate from the crude *Pouteria ramiflora* (Mart.) Radlk extract showed pronounced inhibitory activities of α -amylase and the ethyl acetate fraction was the most active, with 1 mg of this fraction having an antioxidant potential, *in vitro*, equivalent to about 150 mg of ascorbic acid. The results found show that the species in question is promising for the control of diabetes *mellitus* since one of the forms of treatment for the disease is through the use of amylase inhibitors [13]. The search for new therapies for the treatment and cure of diabetes *mellitus* is necessary, as this disease is one of the most common metabolic disorders, with numerous disabling secondary complications [14]. Studies show that inhibition of α -amylase activity can reduce postprandial blood glucose levels and obesity [16].

Correia and collaborators (2016), evaluated the *in vitro* antifungal activity of six species of medicinal plants

from the Brazilian Cerrado against clinically relevant *Candida* species. Among the plant species studied were *Pouteria ramiflora* (Mart.) Radlk and *Pouteria torta* (Mart.) Radlk. which showed significant inhibitory activity against *C. Tropicalis*, *C. krusei*, *C. guilliermondii* and *C. parapsilosis*. The chemical study of *Pouteria ramiflora* (Mart.) Radlk extracts revealed the presence of polyphenols (catechins and flavonoids) as main components, this is an important chemical class with antifungal activity. Considering the growing number of infections by *Candida albicans* and non-*albicans* [17], the importance of this work becomes even clearer. These results can contribute to the frequent search for new natural products with antifungal activity.

One approach to the treatment of diabetes *mellitus* is by inhibiting the activities of α -amylase and α -glucosidase to reduce postprandial blood glucose levels and obesity. Inhibitors of these enzymes reduce postprandial hyperglycemia by slowing carbohydrate digestion and decreasing intestinal glucose absorption [16,18]. An *in vitro* study using aqueous extract of *Pouteria ramiflora* (Mart.) Radlk, *Pouteria torta* (Mart.) Radlk. and *Pouteria caimito* (Ruiz & Pav.) Radlk. showed that these extracts showed inhibitory activities about α -amylase (IC₅₀ 13.6, 7.08 and 5.67 μ g/mL, respectively) and α -glucosidase (IC₅₀ 2.58, 0.35 and 0.22 μ g/mL, respectively) [18]. These results suggest the use of these plants as a potential tool for the development of new therapies for diabetes. As there is an increasing number of individuals with diabetes *mellitus* and its complications in the world, research on medicinal plants effective in the treatment of this disease should be encouraged [19].

In a study where extracts of plant species from the Brazilian Cerrado were evaluated to find potential inhibitors of human salivary α -amylase, ethanolic extracts from *Pouteria ramiflora* (Mart.) Radlk was tested. The parts used were leaves, stems, and roots. In this study, a decrease in amylolytic activity above 95% was observed at a final concentration of 20 μ g/mL. Swiss adult male mice were treated orally with *Pouteria ramiflora* (Mart.) Radlk in studies of acute toxicity and glycemic control. Daily administration with 25, 50, and 100 mg/kg of aqueous extract of this plant for eight days can significantly reduce body weight and blood glucose level in mice [16].

The results of studies using the species *Pouteria ramiflora* (Mart.) Radlk revealed great potential for the treatment of diabetes. Diabetes *mellitus* is the most common disease in the world, about 171 million people were affected in the year 2000, and this number is likely to increase to at least 366 million by 2030. However, more studies should be done to confirm its potential for such

therapy [18]. Studies with the species in question also offers a path for researchers interested in new therapies against cancer. Also, they showed inhibitory activity against *Candida* ssp., which is very promising, since these fungi have been showing great resistance to current antifungals.

Pouteria torta (Mart.) Radlk is a perennial tree widespread in Brazil, popularly called abiu do Cerrado. The fruit and bark of this tree have been used in folk medicine as an antidiarrheal. In its chemical composition we find triterpenes, flavonoids, α - and β -amyrin, lupeol, taraxasterol, pseudotaraxasterol, cycloartenol, lanosterol, α - and β -friedelinol, and acids betulinic and ursolic [6]. The aqueous and ethanol extracts from *Pouteria torta* (Mart.) Radlk leaves showed 94.0% and 91.0% *in vitro* inhibition of α -amylase [20]. It is worth mentioning that extracts obtained from various parts of this plant (leaves, stem, bark or fruit), have several biological activities, such as cytotoxicity, antifungal *in vitro* [6]. These results provide a scientific basis for the use of this plant in popular medicine and suggest that further studies investigate the biological activities of this species.

Studies by Elias and collaborators (2013), on *Pouteria torta* (Mart.) Radlk. intending to investigate the cytotoxic activity and the type of cell death induced by leaf extracts in human mouth squamous cell carcinoma and breast carcinoma cells showed that all the tested extracts, hexanic, ethanolic and aqueous, are cytotoxic on cell lines of cancer OSCC-3 and MCF-7, at different levels. Many types of cancer have resistance to known primary treatment and/or adjuvant therapy, besides, secondary tumors, overgrowth and metastases still prevent the full success of current therapies [21]. In this case, it is worth pointing out that new therapies are necessary to combat neoplasms, and *Pouteria torta* (Mart.) Radlk. presents itself as a promising herbal alternative in this sense.

A study evaluated the mutagenic activity of the hydroethanolic extract of *Pouteria torta* (Mart.) Radlk. in *Salmonella typhimurium* by an *in vivo* micronucleus test in peripheral blood cells of Swiss mice. The results demonstrate that the extract exhibited mutagenic activity in the tests. Mutations are related in the early stages of diseases like cancer. Therefore, the data found suggest caution in the use of this plant in folk medicine. These results demonstrate the danger of inappropriate use of natural products and reinforce the importance of studies on the mutagenicity of compounds obtained from plants [6].

Pouteria lucuma (Ruiz & Pav.) Kuntze known as "gold of the Incas" or "lucuma", is a subtropical fruit from the Andean region of Peru, Chile Ecuador. This plant has

antioxidant, anti-inflammatory, antibacterial, and antifungal activities. However, specific studies on *Pouteria lucuma* (Ruiz & Pav.) Kuntze is very much included. In Peru and Chile, "lucuma" flavored ice cream is very popular, this is due to the sweet taste and wonderful flavor and aroma. Lucuma's meat pulp is rich in carbohydrates, proteins, fibers mainly in an insoluble form, b-carotene, vitamins, and minerals and its non-edible seed is rich in polyunsaturated fatty acids with attributes appreciated by the cosmetic industry in terms of skin regeneration. The study in question highlighted that the biotypes of this plant: Rosalia, Montero and Leiva lucuma have antioxidant and anti-hyperglycemic properties *in vitro*. As chemical and biological activities of this plant come from its constituents, triterpenes and flavonoids [22].

Pouteria lucuma (Ruiz & Pav.) Kuntze seeds are usually disposed of as waste from the agricultural industry. In a study, Guerrero-Castilho and collaborators (2019), found that *Pouteria lucuma* (Ruiz & Pav.) Kuntze seed extracts have moderate to high antioxidant activity and gastroprotective properties [23].

In research aimed at evaluating the effect of lucuma nut oil *Pouteria lucuma* (Ruiz & Pav.) Kuntze on the migration of fibroblasts, on angiogenesis, inflammation, and wound healing, it was observed that the lucuma nut oil contains linoleic acid (38.9%), oleic acid (27.9%), palmitic acid (18.6%), stearic acid (8.9%) and linolenic acid (2.9%). This oil promoted the evolution of migration and the expression of fibroblasts, decreased the production of nitric oxide-induced by LPS. Caudal fin regeneration was observed in zebrafish 48 hours after the caudal fin amputation and accelerated wound closure in CD-1 mice. The fruit of the species in question is very useful in Peruvian gastronomy [24], but its use for therapeutic purposes is still little explored.

Natural products are vital in the discovery of drugs with anti-neoplastic action. A study of the aqueous extract of *Pouteria sapota* (Jacq.) Leaves H.E. Moore & Stearn, a species also known in Central America, Mexico and in many parts of the world as "mamay", was evaluated for its cytotoxic activity. This extract *in vitro* activity against breast cancer cells (MCF-7) (25µg and 125µg). The antioxidant activity was also evaluated and the extract of this plant inhibitory action for the production of free radicals in all the tested tools (25µg, 50µg, 75µg and 100µg). The compounds present in *Pouteria sapota* (Jacq.) H.E. Moore & Stearn as quercetin have a strong cytotoxic against tumor cells, which requires that this activity be promising for new herbal medicines with anticancer properties, however, *in vivo* experiments must be performed for a better understanding of the mechanism [25]. A previous

study by Prabhu and collaborators (2018), demonstrated that aqueous extract from *Pouteria sapota* (Jacq.) H.E. Moore & Stearn and the green synthesis of silver nanoparticles (AgNPs) made from this extract, dissipate as promising for treating diabetes *mellitus*. A reduced reduction in blood sugar levels was observed in treated rats, revealing that both treatments have anti-diabetic activity [26].

Studies carried out using *Pouteria sapota* (Jacq.) H.E. Moore & Stearn dissipated, for the first time, the postprandial absorption of sapote xanthin, a carotenoid important for health, in the human bloodstream [27]. The species (*Pouteria sapota* (Jacq.) H.E. Moore & Stearn) has a lot to offer about anticancer and antidiabetic activities, this may be related to the presence of compounds such as polyphenols and carotenoids, however, it is necessary for further studies to better investigate these actions. According to Prabhu and collaborators (2017), this species has not yet been deeply studied regarding its biological activities [25].

Pouteria campechiana (Kunth) Baehni is used, mainly in Mexico and Cuba, as a medicine for liver and coronary diseases, skin disease, epilepsy, and ulcers. In a study that aimed to investigate the antioxidant and hepatoprotective effect of *Pouteria campechiana* (Kunth) Baehni fruit extract, it was observed that this plant is rich in polyphenolic and flavonoid compounds, beside, the study revealed that the fruit extract exhibiting eliminated free radicals in antioxidant models [28]. Therefore, this plant is promising for the development of new drugs with hepatoprotective and antioxidant action.

Research using four types of plants, including *Pouteria campechiana* (Kunth) Baehni, showed antihyperalgesic effects in diabetic alloxan rats, also, this preparation with plant species demonstrated a dose-dependent systemic antinociceptive effect in rat formalin (1%) and also in capsaicin tests in rats (0.2%) [29]. Therefore, this species can be better investigated and it is promising for new drugs with analgesic function.

The analysis of the components of *Pouteria macrophylla* (Lam.) Eyma popularly known as cutite, originally from the Brazilian Amazon, revealed that this species is rich in hydrolyzable tannins and flavonols. To assess the antioxidant capacity of this plant, Gordon and collaborators (2011), used the total oxidant elimination capacity test (TOSC), where it was possible to observe that the species in question has excellent antioxidant activity by reducing lipid peroxidation (IC₅₀ 0, 57) and peroxynitrite (IC₅₀ 0.83). According to the authors, the antioxidant property of this fruit can be attributed to the phenolic content. In this

study the largest amount of total phenols was found in *Pouteria macrophylla* (Lam.) Eyma [30].

According to Dutok and collaborators (2015) the fruit of *Pouteria mammosa* (L.) cronquist has traditionally been used, mainly in Cuba and Costa Rica, for its medicinal properties against fever, inflammation, rashes, ulcers, nausea, vomiting and diabetes, in addition to being a rich source of nutrients. The common use of the seeds of this plant in ethnobotanical foods and medicines shows low or absent toxicity. The authors conducted a safety test to scientifically support its use in folk medicine and future drug therapies. As a result, they found that orally, the aqueous extract was not toxic to rats, unlike the 25% hydroalcoholic extract that was classified as dangerous. On the skin, both extracts could be used without irritating rabbits, however, both extracts proved to be slightly irritating in eye tests [31]. These data show us that plants and their derivatives are powerful allies in the search for new therapies that aim to combat innumerable diseases, however it is important to spread knowledge about their toxicity, since the incorrect use of these can cause serious damage to health and the death.

Santos and collaborators (2015), carried out an *in vitro* study that aimed to investigate the antimicrobial and cytotoxic potential of four fractions and an ethanolic extract of the species *Pouteria venosa* (Mart.) Baehni is an abundant species in areas of the Atlantic Forest used as a medicinal plant. The antimicrobial activity was determined by disk diffusion microbial sensitivity tests and the broth microdilution method, to determine the Minimum Inhibitory Concentration (CIM). As a result, the crude extract only showed activity in concentrations starting from (CIM 500 µg/mL). The best antimicrobial activities were seen in the fractions against *S. aureus* for the AcOEt fraction of the stem bark (CIM 125 µg / mL); *S. pneumoniae* and *P. mirabilis* for the AcOEt fraction of stem bark (CIM 250 µg / mL); *S. epidermidis*, *P. aeruginosa* for the AcOEt fraction of the leaves and stem bark (CIM 250 µg/mL). In disk diffusion tests, the AcOEt fractions of the leaves and stem barks showed a promising antimicrobial potential with inhibition halos (≥ 17 mm) against the strains of *S. aureus*, *S. epidermidis* and *S. pneumoniae*. They are also active in the *P. aeruginosa* strain, with an inhibition zone between (9 and 14 mm). The most promising fraction was the AcOEt of the stem bark, which is considered non-toxic and can be used in preclinical tests *in vivo* [32]. This study confirms that *Pouteria venosa* (Mart.) Baehni is an excellent antibacterial, this in satisfactory concentrations and can be used in formulations for this purpose.

The importance of plants is increasingly recognized in the formulation of medicines. Also, they already

occupy a large space in gastronomy, aesthetics and wood production. The studies carried out to date with the species of the genus *Pouteria* demonstrate that they offer a wide spectrum in the treatment of diseases. However, most are still little known. In this review, *Pouteria ramiflora* (Mart.) Radlk and *Pouteria torta* (Mart.) Radlk. were plants of the genus that presented the highest number of studies evaluating their therapeutic activities in Brazil, and this may be related to geographical issues, since they are more easily found in Brazil.

IV. CONCLUSION

In summary, the genus *Pouteria* is proven to be effective for the treatment of numerous diseases such as diabetes, cancer and microbial diseases. Also, these plants show promising results as immunomodulators, anti-inflammatory, healing, neuroprotective, antioxidant and hepatoprotective (the plants of this genus should be better investigated for these activities). It is worth mentioning that these species are potent allies in the fight against multidrug-resistant pathogens, which has been a problem mainly in the therapies of immunosuppressed patients. Its active components can later be isolated, characterized and used to develop new drugs. However, most species of this genus are still poorly known, resulting in few studies on their therapeutic activities. In this sense, this study demonstrates the therapeutic potential of the genus *Pouteria* and opens new paths for researchers interested in new effective therapies using herbal medicines.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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